REMARKS:

Applicant has amended the Specification to correct an inadvertent, obvious error.

Applicant has also amended claim 1 to more clearly define the invention, and has added new claims 3-20. Applicant believes that no new matter has been introduced.

I. The Examiner rejected claim 1 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al. (US Patent No. 5,421,987) in view of Dordi et al (US Patent No. 6,416,647). The Examiner stated that:

> Tzanavaras et al teach (see figure 1) a method for electrofilling a metal or alloy inside at least one opening located in a front surface of a substrate, the front surface of the substrate including at least one opening and a top field surrounding the opening, wherein the opening included a bottom and sidewalls coated with an exposed metallic surface, wherein the steps of the method included immersing the substrate in an activation solution (electrolyte), applying high pressure electrolyte jets to the substrate, wherein the electrolyte included metallic ions of the metal to be plated and applying an electroplating current to the substrate to electroplate the metal inside the opening.
>
> Thus, Tzanavaras et al fail to teach applying ultrasonic or megasonic vibrations to the substrate and the electrolyte.
>
> Dordi et al teach (see abstract, figure 3 and related description) including an ultrasonic transducer (237) for agitating the electrolyte in a copper electroplating process.
>
> Therefore, it would have been obvious to one of ordinary skill in the art to have added a step of applying ultrasonic vibrations to the substrate and electrolyte as taught by Dordi et al to the method of Tzanavaras et al because the ultrasonic vibrations would have increased agitation, and thereby, uniformity, of the electrolyte.

Not obvious: Applicant respectfully submits that Claim 1 is not obvious over Tzanavaras et al in view of Dordi et al because there is no suggestion or motivation whatsoever in Tzanavaras et al or in Dordi et al to combine the references.

In particular, Dordi et al states (at col. 13, lines 3-5) that the reason for using an ultrasonic or megasonic is: "To enhance the deposition process, an agitator 237 is preferably attached to the cavity ring 236 to agitate the solution." As the Examiner can readily appreciate from this, Dordi et al teaches the use of megasonic or ultrasonic vibrations **during** plating. Further, and most importantly, Dordi et al does **not** teach, mention, or hint, applying megasonic or ultrasonic vibrations prior to plating. In accordance with the teachings of the specification of the present application (for example, see page 18, paragraphs [0052]-[0053]), applying megasonic or ultrasonic vibrations prior to the plating advantageously improves electrolyte wetting and penetration of the electrolyte into deep openings. In contrast to the teaching of Dordi et al, present Claim 1 recites a step of applying ultrasonic or megasonic vibrations to the substrate that commences prior to the electroplating step. Thus, Applicant respectfully submits

that even if one of ordinary skill in the art were to combine Tzanavaras et al with Dordi et al, that one would not arrive at the invention of claim 1 because there is no teaching or suggestion in Tzanavaras et al or in Dordi et al for applying megasonic or ultrasonic vibrations prior to the plating.

New claims 3-6 depend from claim 1, and Applicant respectfully submits that they are patentable over Tzanavaras et al in view of Dordi et al for the same reasons set forth above with respect to claim 1. Further, Applicant respectfully submits that new claims 7-12 are patentable over Tzanavaras et al in view of Dordi et al for the same reasons set forth above with respect to claims 1-6.

New claims 13-20 all recite a step of dry activation by plasma ashing, sputter etching, plasma etching, or ion bombardment, prior to the step of plating. In accordance with the teachings of the specification of the present application (for example, see page 19, paragraph [0054]), the step of dry activation advantageously improves electrolyte wetting and penetration inside deep openings. Applicant respectfully submits that neither Tzanavaras et al, nor Dordi et al discloses the dry activation step.

For these reasons, Applicant respectfully submits that Claims 1-20 are not obvious over Tzanavaras et al in view of Dordi et al and are, therefore, allowable.

II. The Examiner rejected claim 1 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al. (US Patent No. 5,421,987) in view of Reynolds (US 5,904,827). The Examiner stated that:

> Tzanavaras et al teach (see figure 1) a method for electrofilling a metal or alloy inside at least one opening located in a front surface of a substrate, the front surface of the substrate including at least one opening and a top field surrounding the opening, wherein the opening included a bottom and sidewalls coated with an exposed metallic surface, wherein the steps of the method included immersing the substrate in an activation solution (electrolyte), applying high pressure electrolyte jets to the substrate, wherein the electrolyte included metallic ions of the metal to be plated and applying an electroplating current to the substrate to electroplate the metal inside the opening.
>
> Thus, Tzanavaras et al fail to teach applying ultrasonic or megasonic vibrations to the substrate and the electrolyte.
>
> Reynolds teaches (see abstract, figure 3 and related description) including an megasonic transducer (90-92) for agitating the electrolyte in a copper electroplating process.
>
> Therefore, it would have been obvious to one of ordinary skill in the art to have added a step of applying megasonic vibrations to the substrate and electrolyte as taught Reynolds teaches (see abstract, figure 3 and related description) including an megasonic transducer (90-92) for agitating the electrolyte in a copper electroplating process.
>
> Therefore, it would have been obvious to one of ordinary skill in the art to have added a step of applying megasonic vibrations to the substrate and electrolyte as taught by Reynolds to the method of Tzanavaras et al because the megasonic vibrations would have increased uniformity of the electroplating (see Reynolds at col. 8, lines 45-56).

Not obvious: Applicant respectfully submits that Claim 1 is not obvious over Tzanavaras et al in view of Reynolds because there is no suggestion or motivation whatsoever in Tzanavaras et al or in Reynolds to combine the references.

In particular, Reynolds states: (a) (at col. 1, lines 20-23): "a fluid powered rotary wiper, in combination with the megasonic action of the transducer, ensures efficient and uniform plating"; and (b) (at col. 5, lines 3-5): "The combination of rotary blade and megasonic agitation avoids regions of dead flow and ensures uniformity of the metallization thickness and uniformity." However, a person of ordinary skill in the art, considering the use of the jets plating of Tzanavaras et al, would have no motivation to consider improving the plating uniformity, or eliminating regions of dead flow in the electrolyte, since Tzanavaras et al already states: (a) (at col. 3, lines 13-16) regarding the jets electroplating cell, that: "The impinging powerful jets create turbulent flow at the substrate's surface, thus providing efficient agitation and replenishment in all areas ..."; (b) (at col. 3, lines 31-34): "The turbulent flow and pulsating action prevent the formation of stagnant (and depleted) electrolyte solution in deep and narrow mask openings."; and (c) (at col. 3, lines 61-63): "An object of this invention is to provide an electroplating cell for plating alloys having superior macro and micro-uniformities at a high rate of processing." As the Examiner can readily appreciate from this, Tzanavaras et al states that the goal of avoiding regions of dead flow and the goal of achieving improved uniformity are accomplished by using the cell and method of Tzanavaras et al alone. As such, there is no suggestion, or motivation, whatsoever, in Tzanavaras et al to look for further improvements by other techniques.

Applicant further submits that Reynolds teaches the use of megasonic or ultrasonic vibrations **during** plating, i.e., Reynolds does **not** teach, mention, or hint, applying megasonic or ultrasonic vibrations prior to plating. In accordance with the teachings of the specification of the present application (for example, see page 18, paragraphs [0052]-[0053]), applying megasonic or ultrasonic vibrations prior to the plating advantageously improves electrolyte wetting and penetration of the electrolyte into deep openings. In contrast to the teaching of Reynolds, present Claim 1 recites a step of applying ultrasonic or megasonic vibrations to the substrate that commences prior to the electroplating step. Thus, Applicant respectfully submits that even if one of ordinary skill in the art were to combine Tzanavaras et al with Reynolds, that one would not arrive at the invention of claim 1 because there is no teaching or suggestion in Tzanavaras et al or in Reynolds for applying megasonic or ultrasonic vibrations prior to the plating.

New claims 3-6 depend from claim 1, and Applicant respectfully submits that they are patentable over Tzanavaras et al in view of Reynolds for the same reasons set forth above with respect to claim 1. Further Applicant respectfully submits that new claims 7-12 are patentable over Tzanavaras et al in view of Reynolds for the same reasons set forth above with respect to claims 1-6.

New claims 13-20 all recite a step of dry activation by plasma ashing, sputter etching, plasma etching, or ion bombardment, prior to the step of plating. In accordance with the teachings of the specification of the present application (for example, see page 19, paragraph [0054]), the step of dry activation advantageously improves electrolyte wetting and penetration inside deep openings. Applicant respectfully submits that neither Tzanavaras et al, nor Reynolds discloses the dry activation step.

For these reasons, Applicant respectfully submits that Claims 1-20 are not obvious over Tzanavaras et al in view of Reynolds and are, therefore, allowable.

III. The Examiner rejected claim 2 under 35 U.S.C. 103(a) as being unpatentable over Tzanavaras et al. (US Patent No. 5,421,987) in view of either Dordi et al (US 6,416,647) or Reynolds (US 5,904,827) as applied to claim 1 above, and further in view of Langner et al (US 4,834,842). The Examiner stated that:

> The teachings of Tzanavaras et all Dordi et al and Reynolds are described above.
>
> None of these references expressly teach that the electrolyte plating bath included an inhibitor additive.
>
> Langer et al (see abstract and col. 1, lines 18-34) a conventional additive for copper electroplating baths included inhibitors. The inhibitors were added to ensure a uniform deposit.
>
> Therefore, it would have been obvious to one of ordinary skill in the art to have added an inhibitor as taught by Langer et al to the electrolyte of Tzanavaras et al because the inhibitor increased uniformity of the electroplated metal.

Not obvious: Applicant respectfully submits that, for the reasons discussed above in Sections I and II, claim 1 is allowable over Tzanavaras et al in view of Dordi et al or Reynolds and, since claim 2 depends from claim 1, it is also allowable over these references. The addition of Langer et al does not affect, whatsoever, the allowability of claim 1. Therefore, Applicant respectfully submits that claim 2 is allowable over Tzanavaras et al in view of Dordi et al or Reynolds and further in view of Langner et al.

III. Double Patenting.

The Examiner rejected claims 1-2 on the grounds of non-statutory obviousness-type double patenting as being unpatentable over claims 33-38 of (Applicant's) U.S. Patent No. 6,869,515.

Applicant has attached here a Terminal Disclaimer and the appropriate Fee, in order to overcome this rejection.

Respectfully submitted,

Dated: 6/21/2006

By _____
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